Chapter 1
Introduction

1-1. Purpose and Scope

This manual provides guidance on the formulation, design and performance of beach fill projects. Such projects are undertaken to protect backshore development from flood and storm waves. Sand bypassing operations are not covered since these procedures are covered in Engineer Manual (EM) 1110-2-1616.

1-2. Applicability

This manual is applicable to Headquarters, U.S. Army Corps of Engineers (HQUSACE) elements and USACE Commands having civil works engineering and design responsibility.

1-3. Definition

The term beach fill commonly refers to both a process and a substance. The beach fill process is an operation involving placement of suitable sand, transported from an outside source, on a specific shore area. Beach fill also refers to the borrow material that is placed on the beach. In this manual the terms beach fill operation and beach fill project will refer to the process, and beach fill material will refer to the substance.

1-4. References

a. ER 1110-2-1407, Hydraulic Design of Shore Protection Projects.

b. ER 1110-2-2902, Prescribed Procedures for the Maintenance and Operation of Shore Protection Works.

c. EP 415-1-4, Network Analysis System Guide.

d. EM 1110-1-1000, Photogrammetric Mapping.

e. EM 1110-1-1802, Geophysical Exploration.

f. EM 1110-1-1804, Geotechnical Investigations.

g. EM 1110-2-1003, Hydrographic Surveying.

h. EM 1110-2-1004, Coastal Project Monitoring.

i. EM 1110-2-1412, Storm Surge Analysis and Design Water Level Determinations.

j. EM 1110-2-1414, Water Levels and Wave Heights for Coastal Engineering Design.

k. EM 1110-2-1502, Coastal Littoral Transport.

l. EM 1110-2-1614, Design of Coastal Revetments, Seawalls, and Bulkheads.

m. EM 1110-2-1616, Sand By-passing Operations.

n. EM 1110-2-1617, Coastal Groins and Nearshore Breakwaters.

o. EM 1110-2-1618, Coastal Inlets Hydraulics and Sedimentation.

p. EM 1110-2-1810, Coastal Geology.

q. EM 1110-2-1906, Laboratory Soils Testing.

r. EM 1110-2-1907, Soil Sampling.

s. EM 1110-2-2904, Design of Breakwaters and Jetties.

t. EM 1110-2-3300, Beach Erosion Control and Shore Protection Studies.

1-5. Bibliography

Technical and Scientific Literature. Appendix A contains a selected bibliography of technical and scientific literature pertaining to beach fill planning and design. Publications of particular value and comprehension are the 1984 edition of the Coastal Engineering Research Center (CERC) *Shore Protection Manual*, "Guidelines for Beach Restoration Projects" and the *Manual on Artificial Beach Nourishment* (Delft (Netherlands) Hydraulics Laboratory 1986). Appendix A also contains references to each publication cited in this manual.

1-6. Background

Beach fill projects involve the placement of sand along beaches to replace material lost by erosion or to increase beach width and dune elevations to provide protection of inland areas against storm flooding and waves. Many fill projects are initiated because the project beach has eroded and no longer acts as an effective buffer between land and sea. Initial fill is usually directed at increasing the width and height of the beach and foredunes to restore their protective function, and, as an added incidental benefit, create increased area for recreational use. Beach fills are commonly placed on naturally eroding shorelines which have deficit sediment supplies. Therefore, intermittent additional fill will be necessary over the long term. Despite these periodic nourishment costs, beach fills are considered an option to the initial construction of hard structures such as groins, revetments, bulkheads, or seawalls, which ideally would reduce long-term erosion along the shorelines. It is for this reason that renourishment operations are cost-shared with non-Federal sponsors in the same proportion as the initial construction hard structures. Renourishment is evaluated for cost-effectiveness versus the construction costs of structures. Depending on the economics of a particular project, a beach fill combined with a hard structure may prove to be the most cost-effective solution to the problem. Fill that is lost to the project is most often transported downdrift. However, periodic reversals of longshore transport processes also cause fill material to be carried updrift from the nourished area. Either way, the fill material acts as nourishment for adjacent beaches, having beneficial effects on both downdrift and updrift beach areas.

a. Design parameters. A large number of factors must be taken into account for economic analysis, planning, and design of beach fills. Each beach is unique in terms of its environmental situation, configuration, and composition. Consequently, selection of design parameters should be made on the basis of accurate up-to-date information on the project beach, and environmental factors such as wave climate and littoral currents. The principal design parameters of a beach fill project are tidal characteristics; wind and wave climate; storm characteristics; shoreline change history; sediment characteristics; sediment budget; borrow material availability and suitability; and environmental considerations. These parameters are used to evaluate the "without project" conditions and alternative "with project" parameters such as: the berm elevation and width, dune elevation and volume, project boundaries and termination of fill, required frequency of refilling, and fill material properties. Berm and dune elevations are selected to reduce the occurrence of overtopping during storms. Combinations of all fill dimensions should be considered by optimization design procedures to evaluate various combinations of fill dimensions to determine the protective value that produces the maximum net benefit. Advanced nourishment is designed to counter long-term erosion effects for a number of years before refilling becomes necessary. Project boundaries and termination of the fill influence project impact on adjacent beaches and project life.

b. Materials selection. A number of important considerations are involved in selecting a fill material source for a beach fill project. The most important factors are the grain size distribution of the fill material as compared to the native beach material, and accessibility of the borrow source. It has been found that, in general, material with grain size characteristics equal to or somewhat coarser than the native beach material is most satisfactory for beach fill. However, the ideal fill material often cannot be located within an economical hauling or pumping distance, or is otherwise unavailable because of environmental constraints, excessive overburden, legal or political constraints, or difficulty of access. In these cases the design process may be able to adapt less than ideal borrow material for project use by increasing the quantity of fill material placed, or by incorporating shore protection structures into the design.

c. Economics. Overall project economics will control the most cost-effective level of protection supplied by a beach fill project. Generally in a beach fill project the object of the economic analysis will be to maximize net benefits; i.e., the difference in damages to a project area between without-project and with-project conditions. A variety of beach widths and dune geometries are analyzed to determine the optimum level of protection, as measured by estimated average annual project benefits, and project cost. The design providing the maximum net estimated average annual benefits will be selected for construction. The reader is referred to USACE (1991) IWR Report 91-R-6, "National Economic Development Procedures Manual - Coastal Storm Damage and Erosion," for detailed guidance on the economic evaluation of beach fill projects.